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REARING THE WESTERN TUSSOCK MOTH ON ARTIFICIAL DIET WITH APPLICATION TO RELATED SPECIES

LINDA J. PETERSON

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE
PORTLAND, OREGON

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Reference Abstract

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This paper describes an artificial diet and a rearing procedure for the western tussock moth, *Orgyia cana* Edwards. The diet and rearing regime permit laboratory production of successive generations of the species with continued maintenance of insect vigor and reproductive capability. The diet and rearing techniques are also applicable to other species including the Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough), and the rusty tussock moth, *O. antiqua* (Linn.).

KEYWORDS: Insect rearing, artificial diet, tussock moth (western), *Orgyia cana*, tussock moth (Douglas-fir), *Orgyia pseudotsugata*, tussock moth (rusty), *Orgyia antiqua*.

RESEARCH SUMMARY
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This paper describes an artificial diet and a rearing procedure for the western tussock moth, *Orgyia cana* Edwards. The diet and rearing regime permit laboratory production of successive generations of the species with continued maintenance of insect vigor and reproductive capability. A low mortality incidence and a uniform growth rate support the effectiveness of both diet and technique in providing adequate nutrition and a suitable physical environment. As a direct result of the high survival rates and uniform growth patterns observed at all stages of insect development, the rearing program is efficient in labor and materials and is adaptable to a mass-rearing project.

A significant feature of the *O. cana* diet and rearing methodology is the applicability of the program to other insect species, including the Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough), and the rusty tussock moth, *Orgyia antiqua* (Linn.).

and allowed to solidify; (8) the medium is then cut into 2.5- x 2.5-cm pieces for use--any diet not used immediately can be stored up to 7 days at 2°C.

REARING METHODS

Collection and Treatment of Eggs.--Egg masses from laboratory rearings are maintained at ambient temperatures for approximately 30 days following oviposition prior to subjection to an obligatory cold treatment at 2°C and 45-percent RH for a minimum of 3 months. Following this cold treatment, the eggs are surface-sterilized in a 0.1-percent sodium hypochlorite solution (2 percent of a 5-percent commercial bleach preparation); this precautionary step eliminates the possibility of contamination by microbials or viruses (Getzin 1962). The sterilized eggs are held at 25°C and 45-percent RH with a 12-hr light-dark cycle; under this regime, eclosion occurs in 12-14 days.

Handling and Feeding of Larvae.--Newly hatched larvae (less than 24 hr in age) are transferred with a camel's-hair brush to disposable 15- x 100-mm petri dishes which serve as rearing containers (Lyon and Flake 1966). Ten larvae are placed in each dish, along with a piece of artificial medium; the dishes are then arranged in single layers on shallow rearing trays. For the larval feeding period the environmental conditions are maintained at 25°C, 45-percent RH, with a 12-hr photoperiod. The insects are refed every 7 days: the old medium is removed from the dish and is replaced with fresh diet. As 21-25 days are needed for larvae to reach pupation, a maximum of three refeedings is required.

Collection and Sexing of Pupae.--The newly developed pupae (less than 24-hr-old) are removed from the rearing dishes and sexed on a regular, daily basis; this grouping of pupae by age and sex is necessary in order to achieve optimum adult mating success, as well as to insure accuracy in experimental studies. Collection and sexing are accomplished with accuracy and efficiency by using an ordinary photographic light table and employing the following technique: individual rearing dishes are placed on the light table where the illumination from beneath permits the viewer to see into the newly spun cocoons and discern both the stage of pupal development and the sex. A smooth, dark, sclerotized shell characterizes a fully formed pupa. Male and female forms are easily distinguished on the basis of size and shape. The male pupa has a flattened anterior end, a narrow thorax, and an average length of 1.5 cm. The female pupa is considerably larger, averaging 2.3 cm in length with a pointed anterior end and a wide thorax. When the collected pupae are held under a regime of 25°C, 45% RH with a 9- to 12-hr photoperiod, adult emergence (male and female) occurs in 10 or 11 days.

Mating and Oviposition of Adults.--As soon as pupae are collected and sexed, those destined for use in propagation are set up in mating/oviposition containers. In this way, the need to handle adult moths is completely eliminated and emergence occurs in an unhampered manner. Preparation of the mating/oviposition container is as follows: female pupae (cocoons intact) are affixed to 6- x 8-in (15.2- x 20.3-cm) index cards with paper mucilage--20 females per card (fig 1). This card and 20-25 loose male pupae are placed inside a 5-lb Kraft paper bag (fig 2). The male pupae should be 24-48 hr older than female pupae; in this way, sexually mature males are available for mating with emerging females for optimum mating success. The mating/oviposition bag is stapled shut and set aside at 25°C, 45-percent RH, with an 8-hr photoperiod; no further handling is required until the egg masses are collected 30 days later.

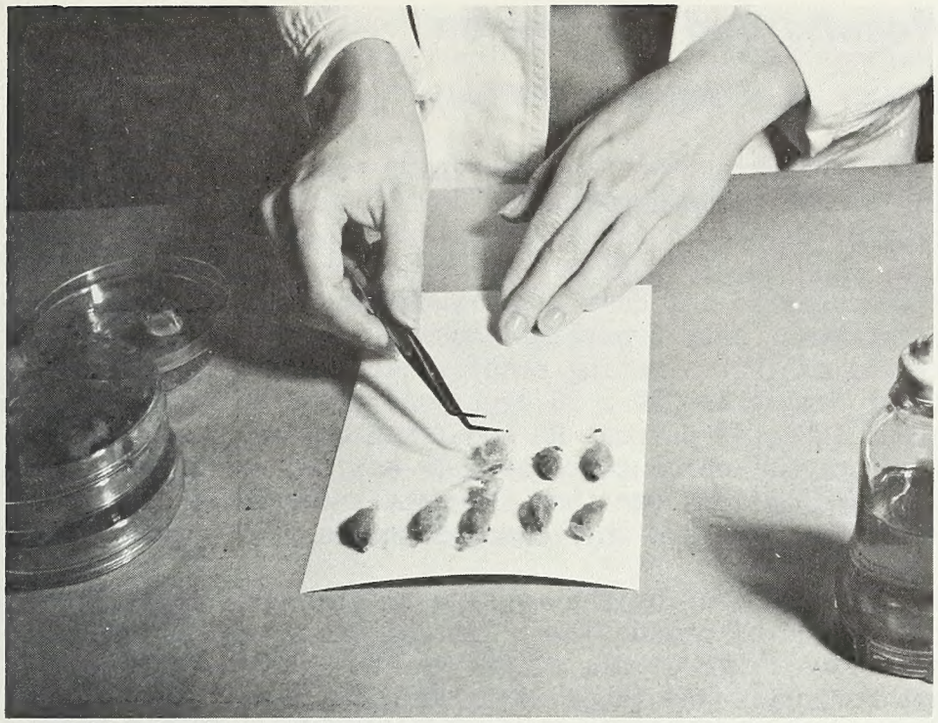

Figure 1.--Affixing female pupae in cocoons to a 6 X 8-in (15.2 X 20.3-cm) index card.

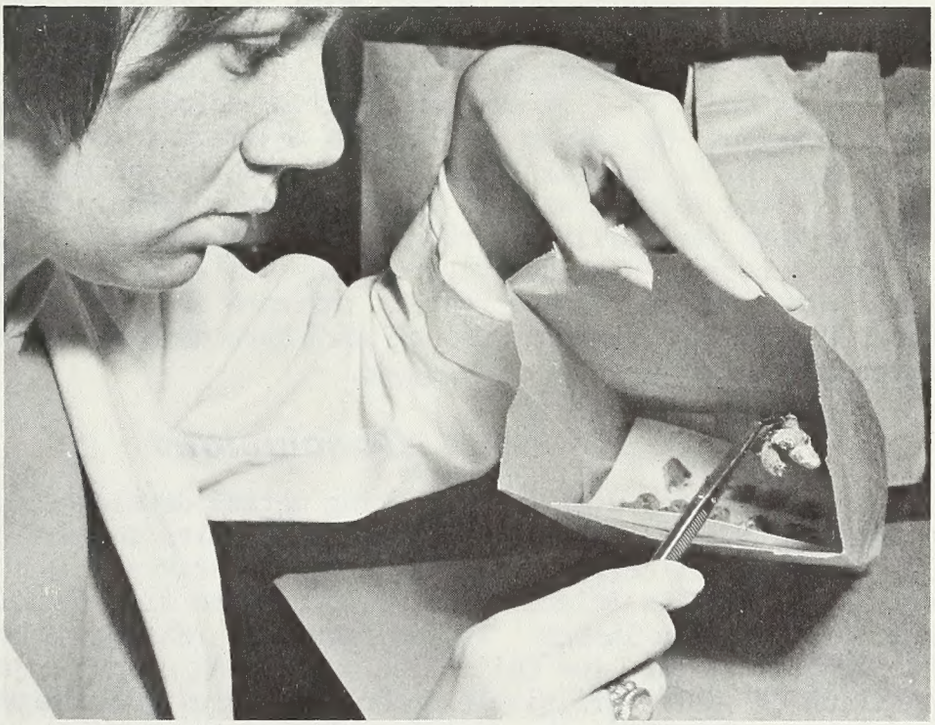

Figure 2.--Adding male pupae to a mating/oviposition bag containing card with female pupae in cocoons.

Results and Discussion

EFFECTIVENESS AND EFFICIENCY OF REARING PROGRAMS

The artificial diet and procedures for the laboratory rearing of *O. cana* are successful in producing healthy insect specimens in all life-cycle stages. Results based on the rearing of five successive laboratory generations (averaging 4,000 larvae per generation) show the following: larvae develop rapidly and uniformly (L_1 to pupation averages 23 ± 2 days), pupae develop into adults at a consistent rate with a mortality of only 5 percent, adults emerge with no signs of wing or scale deformity and exhibit a mating success rate of 90 percent ± 5 percent, egg production per female is 250 ± 50 eggs, and eclosion from eggs held under optimum conditions (2°C, 45-percent RH for 3 months) is 90 percent ± 10 percent. As no loss of vigor or reproductive ability has been observed with five successive generations, indications are that the diet and methodology fully satisfy the nutritional, reproductive, and environmental needs of *O. cana*.

In addition, the rearing procedure for the western tussock moth represents an efficient and economical method of production. The uniform growth patterns and the consistently high survival rate at all stages of development permit efficient handling and keep materials and labor costs at a minimum. The techniques are also easily adjusted to meet varying research demands, ranging from small-scale stock maintenance to large-scale, mass-rearing programs.

APPLICATION TO OTHER SPECIES

The diet and rearing techniques developed for the western tussock moth have yielded similar positive results when applied to certain related insect species. Currently, the Douglas-fir tussock moth, *O. pseudotsugata* (McDunnough) is being reared successfully in large numbers using the diet and procedures described. Overall success is comparable to that of *O. cana*; however, larval development time is extended by 7-10 days and optimum eclosion occurs after a more extensive cold treatment (4.5 mo at 2°C). In addition to *O. pseudotsugata*, the rusty tussock moth, *O. antiqua* (Linn.) and the white-marked tussock moth, *O. leucostigma* (J. E. Smith) respond well to this rearing program. While these latter species exhibit more variability in regard to optimum cold treatment duration and larval development time, healthy, vigorous insects with high survival and reproductive rates are produced. These results indicate that the diet and methodologies described for the western tussock moth have extensive application in rearing several species of the genus *Orgyia*.

Conclusions

An artificial diet and a rearing method developed for the western tussock moth, *Orgyia cana* Edwards, provide an effective and efficient means of producing large numbers of healthy insects in the laboratory. The preparation of the artificial diet is relatively simple, and the diet formula provides adequate nutrition for the insect. In addition, the rearing methods devised for the handling of larvae, the collection and sexing of pupae, and the mating and oviposition of adults are simple techniques requiring minimal inputs of materials and labor. Together, the diet formula and the rearing techniques result in a high survival rate as well as uniform development of the insect in all life-cycle stages.

Of additional importance is the fact that the diet and procedures for rearing *O. cana* are applicable to other related species, including the Douglas-fir tussock moth and the rusty tussock moth.

Literature Cited

Addy, N. D.
1969. Rearing the forest tent caterpillar on an artificial diet. J. Econ. Entomol. 62:270-1.

Dupnik, T. D., and J. A. Kamm.
1970. Development of an artificial diet for *Crambus trisectus*. J. Econ. Entomol. 63:1578-80.

Ferguson, Douglas C.
1978. The Moths of America north of Mexico: Fascicle 22.2 Noctuoidea, Lymantriidae. E. W. Classey Limited, London. 110 pages.

Getzin, L. W.
1962. Mass rearing of virus-free cabbage loopers on an artificial diet. J. Insect Pathol. 4:486-8.

Lyon, R. L, and H. W. Flake, Jr.
1966. Rearing Douglas-fir tussock moth larvae on synthetic media. J. Econ. Entomol. 59:696-8.

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